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DIFFERENTIAL PERFORMANCE
OF FLEET AND RECRUIT PERSONNEL
IN TORPEDOMAN'S MATES SCHOOL

A Technical Report

prepared by

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Abstract

The purpose of this study was to evaluate the influence that certain background and training factors may have upon the relationships between test scores and criterion measures. Enlisted personnel who enter Navy training schools come either from the fleet or directly from recruit training schools. Whether the fleet personnel perform better or poorer, in relation to ability, than do the personnel who come from recruit training centers is a question of considerable importance for selection procedures.

The results of the study indicate that the fleet subjects earned higher grades in a Torpedoman's Mates School than did recruit subjects who had similar scores on tests from the Navy Basic Battery. Although the factors of age and education were significantly correlated with school grades, these factors did not appear to account for the superior performance of the fleet subjects.

Another factor that may have operated in favor of the fleet subjects was their past experience with mechanical-motor activities. The influence of this factor was examined in two ways. When defined on the basis of scores obtained from a check list of mechanical-motor tasks, such indices of previous experience failed to correlate significantly with either school grades or predictor variables. However, analysis did disclose a tendency for the fleet subjects to earn higher scores than did recruits on a learning task involving the assembly of a breech block mechanism, when scores from the Navy Basic Battery were taken into consideration. When an attempt was made to partial out the influence of previous mechanical-motor experience by taking into account the scores on the learning task, course grades for fleet subjects still tended to be higher than those for recruits. The findings thus suggested that there were additional factors accounting for the better school performance of the fleet subjects. Several hypotheses regarding the nature of these factors were formulated.

Since the study led to the conclusion that the two groups had performed significantly differently in school with ability taken into account, separate selection procedures are recommended for the two groups. Further research is suggested to determine whether similar differences prevail in other Navy training schools. If so, research studies aimed at the identification of the factors related to the better performance of the fleet personnel might be initiated.

Acknowledgments

DIFFERENTIAL PERFORMANCE OF FLEET AND RECRUIT

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Introduction

Frequently candidates for industrial jobs or schools are drawn from several different sources. An important problem that arises is whether a different selection procedure should be used for candidates from each source, or whether the characteristics of these groups of individuals are sufficiently similar to make a single selection procedure appropriate. In the Navy, this type of problem occurs when students for training schools are selected either from the fleet or from recruit training centers, with such selectees obviously differing with respect to their experience in the Navy. For some Navy schools, to be selected from recruit training centers a recruit must have test scores at or above established critical scores, whereas for students from the fleet this requirement may be waived in some instances.

This project was undertaken in order to evaluate the influence which such background and training factors might have upon the relationships between test scores and criterion measures. The results of such a study were expected to be of value in indicating circumstances under which the predictiveness of test scores might be markedly affected, and thus to be of aid in the further development of Navy selection and classification procedures.

The relationship between school grades and scores on a selection test in a situation where a cutting score on a selection test is employed for a portion of the students is schematically represented in Figure 1.

The conventional procedure for developing an equation for predicting course grades from test scores is equivalent to determining the average course grade made by the group of individuals who have scores in each of several score intervals on the selection test. By plotting these pairs of numbers as points and drawing a straight line through them, one would obtain a regression line for each group of individuals similar to the lines shown in Figure 1.
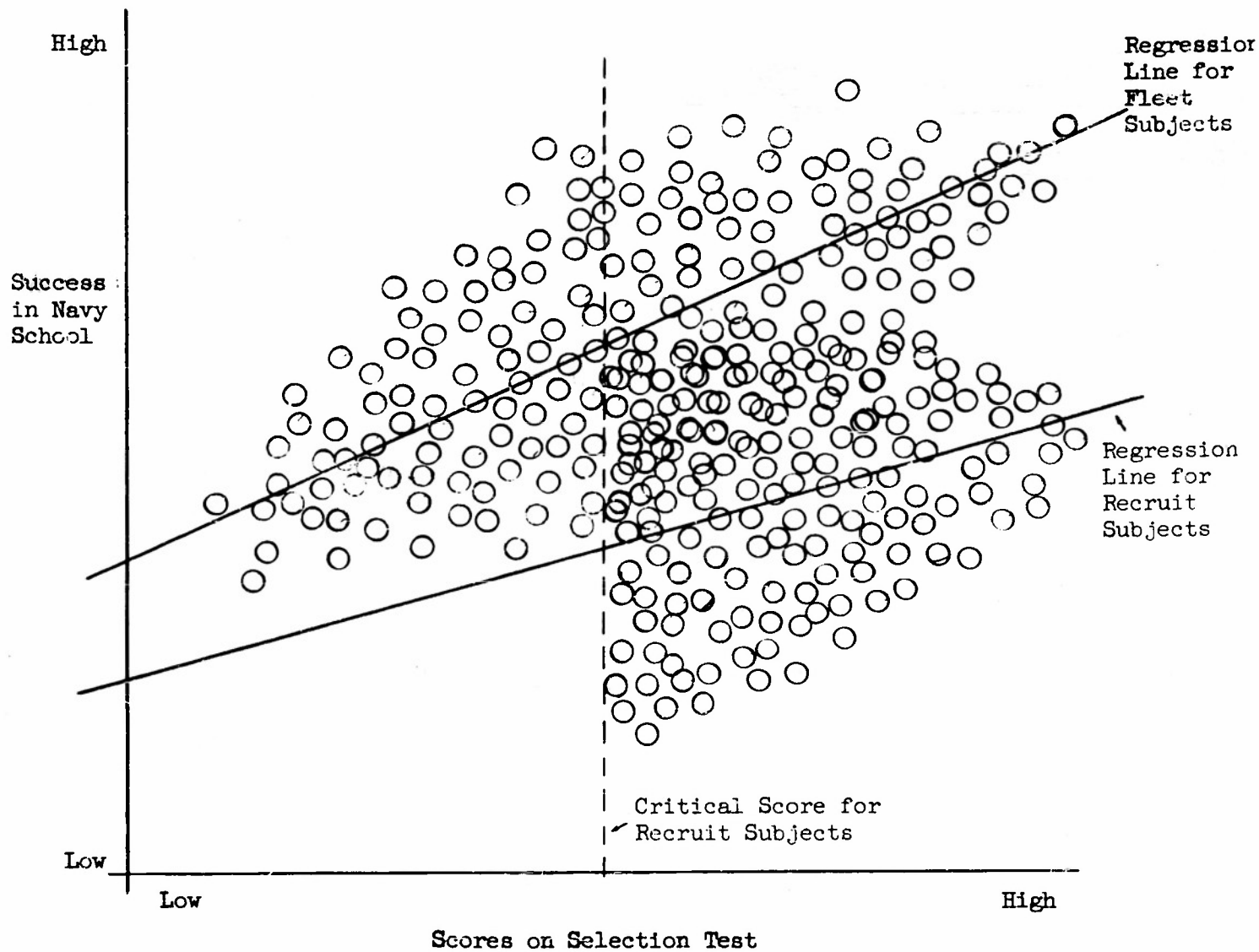
Figure 1. A hypothetical illustration of the relationship between measures
of success in a Navy school and scores on a selection test. The
figure represents the situation where a minimum score has been
established for one group of subjects, say the recruit subjects.
Since the regression of success on selection test scores is not
influenced by this cutting score, the regression lines of the two
groups may be compared. In this hypothetical case, the slopes
and vertical intercepts are sufficiently different to warrant
separate prediction equations for the two groups. Had the re-
gression lines coincided, a single prediction equation would
suffice.

When a regression line is constructed in this manner, it should be noted that the slope of the line and the point at which it intersects the vertical axis should be the same whether it is based upon the scores to the left of the critical score, those to the right, or for all scores on the selection test. If the subjects from the fleet and recruit training centers earn about the same course grades relative to their scores on the selection test, the regression lines should coincide. If one group of subjects earn higher grades relative to their ability on the selection test than do the other, then the regression lines for the two groups may have different slopes and different intercepts with the vertical axis. In that event, separate selection procedures would seem advisable.

We have just given an intuitive, non-rigorous statement of the problem confronted in this study, namely, to determine whether the regression of Navy grades on selection test scores is the same for fleet subjects as for recruit subjects.

Procedure

The data upon which this study was based were secured in connection with another study (1) in which learning measures were developed as a possible predictor of success in a Torpedoman's Mates School. The study was conducted during the last six months of 1952 at a Class "A" Torpedoman's Mates School. The sixteen-week program in this school provided training on the checking, maintaining, testing, repairing, and overhauling of underwater ordnance used on naval vessels and aircraft, including torpedoes, depth bombs, depth charges, and ordnance detectors.

Two hundred and seventy-six students from six consecutive classes at the school participated in the study. Ninety-five of these students had been selected from the fleet, whereas the remaining one hundred and eighty-one had been selected from recruit training centers. These two groups will be designated fleet and recruit, respectively.

The principal factor in the selection of students for the Torpedoman's Mates School was performance on the Mechanical Aptitude Test, a score of 55 or better being required for selection; this score is ex-

ceeded by approximately 31% of all Naval enlisted personnel. Less than two per cent of the recruit subjects in the study were found to have scores below this point. However, in the case of fleet personnel (for whom this requirement was often waived for various reasons), approximately one-half of the subjects in the study were found to have scores below the cutoff point.

A more recent basis for selection is a minimum combined score of 105 on the Arithmetic Test and Mechanical Aptitude Test. However, about one-half of the subjects, both recruit and fleet, had combined scores below this cutoff point. For this reason, it will be assumed that the Mechanical Aptitude Test was the essential basis for selection.

The predictor variables. Scores on tests in the Navy's Basic Battery were already available in the records of the subjects, the testing having occurred prior to selection. Brief descriptions of these tests follow:

1. General Classification Test. This is a test of verbal ability based upon three types of items: Sentence Completion, Opposites, and Analogies.

2. Arithmetic Test. Items in this test are of two types: (a) problems involving routine computation, and (b) verbally stated problems measuring ability to think in quantitative terms.

3. Mechanical Aptitude Test. This test consists of two parts: (a) mechanical and electrical knowledge, and (b) mechanical comprehension. The latter involves the ability to perceive visually the mechanical details of a problem situation, and to apply various physical principles to arrive at a solution.

4. Clerical Aptitude Test. This is a speeded test requiring name checking and number checking.

The above four tests are standardized Navy tests whose scores have a mean of 50 and a standard deviation of 10 in a population of all Naval enlisted personnel. The following additional test was employed:

5. Block Counting Test. Since it is possible that the Basic Battery may later include a spatial test, the Classification and Survey

Branch, Personnel Analysis Division, Bureau of Naval Personnel, requested that two tests of spatial ability be administered at the same time as the experimental tests described below. One of the spatial tests was a conventional block counting test.

The second spatial test was a surface development or pattern arrangement test in which the subject was required to transform visually a two-dimensional projection to three dimensions as shown in perspective. During the experimental testing it became apparent that the directions for this latter test were not adequate and, therefore, data for this test are not included in the analysis reported below.

The experimental variables. In addition to the spatial tests described above, several experimental tests were administered to the subjects during their first week of instruction at the Torpedoman's Mates School. Two of these tests are relevant to this report.

1. Breech Block Performance Test. The primary aim of the companion study (1) was to develop measures of learning ability that would predict future performance in schools teaching mechanical-motor skills, and to determine whether such measures would increase the predictive efficiency of currently-used selection instruments. That study is described in detail in reference 1. The experimental design of the learning study was to create a miniature training situation and to follow that by a testing session. Since the Torpedoman's Mates School was primarily concerned with the development of mechanical-motor skills, such as assembly-type operations, performance testing appeared to be an appropriate medium for the measurement of learning.

A sound film describing the step-by-step assembly of the breech block of a 40 mm. antiaircraft gun constituted the training material. The original film from which this film was taken had been developed for Special Devices Center of ONR by Pennsylvania State College. The training film (approximately two minutes) was presented to the subjects who were then given three minutes to assemble as much of the breech block as possible. Following the first trial the subjects again were shown the film. Subsequently, they were given another three-minute period on the actual assembly task. This procedure was repeated for a total of five cycles. Each time, a proctor rated each subject's

performance, using a specially prepared objective record sheet. For each assembly trial, the subject was given separate scores for the number of steps completed correctly and the amount of time consumed. The learning score reported in the present analysis was the cumulative rate of work for the five trials. Other learning measures and their relationships with the other variables are discussed in the report of the companion study.

2. Experience Check List. The possibility that previous experience in mechanical-motor activities might be a concomitant of performance on the learning task led to the development of an experience check list of 142 items. The following are examples of the type of questions included: Have you driven a tractor? operated a power hammer? changed a tire on a car? fixed a leaky water tap? shingled a roof? done any kind of riveting? operated sound recording equipment? installed or repaired telephones? assembled or disassembled a watch or clock? and so on. For each item the subject indicated whether he had had no experience, had performed the task but did not believe he was skilled, or had performed the task sufficiently to have acquired a considerable degree of skill. The scores on the Experience Check List were simply the number of responses in each of the three categories, designated throughout this report as ECL-A, ECL-B, and ECL-C, respectively.

More than half of these items came from an Experience Record developed for a different purpose by Professor Robert L. Thorndike of Teachers College, Columbia University, under an USAF contract. The remainder of the items were developed by the present writer.

The criterion variables. Two criteria of success in the Torpedoman's Mates School were obtained.

1. Average grade on weekly performance tests. This score was the average score on nine or more of the eleven weekly performance tests administered during the training course. These performance tests were based upon such topics as main engines, gyros, basic electricity, Mark 27 torpedo, and so on.

2. Final grade in course. This grade was a composite of the average weekly grade (60%), the grade earned on the final written

test (20%), and the grade earned on the final identification test (20%). The average weekly grade was obtained by weighting the average grade on the weekly performance tests 60%, the average grade on weekly written tests 20%, and the average grade on weekly identification tests 20%. These percentage weights do not take into consideration the intercorrelations or the variabilities of the measures involved, and thus do not necessarily represent the effective weights of these variables.

All of the above criterion tests were objective-type tests constructed by staff members of the Torpedoman's Mates School. To maintain test security, some of the tests had to be modified from time to time. The Torpedoman's Mates School lacked the necessary facilities to insure that the various forms of any test were parallel, which meant that the criteria have an unknown amount of variability from class to class. It would have been preferable for research purposes, and perhaps for the purposes of the Torpedoman's Mates School itself, to have available final performance and achievement tests which have been standardized and which have alternate parallel forms. This would permit a certain amount of stability in the criteria when successive classes are to be compared or combined.

Results and Discussion

In order to facilitate presentation of the results and appropriate discussion, this section is divided into three parts: (1) the relationship between the criteria and selected predictor variables; (2) the influence of age, education, previous mechanical experience, and learning ability on the relations between tests and criterion measures; and (3) the factors hypothesized to account for better performance of fleet personnel. The nucleus for these parts is Table 1, which contains the intercorrelations of the predictor, experimental, and criterion variables, together with their means, standard deviations, and standard errors of estimate.

Relationship between the criteria and selected predictor variables. The means and standard deviations for the recruit subjects and the fleet subjects were approximately the same on the General Classification Test,

TABLE 1

Intercorrelations, Means, Standard Deviations, and Standard Errors of Estimate

($N_F = 95$ and $N_R = 181$)

		BASIC BATTERY					EXPERIMENTAL AND BACKGROUND VARIABLES						CRITERIA				STANDARD ERROR OF ESTIMATE		
		GCT	ARI	MA	CA	Spa	ECL-A	ECL-B	ECL-C	BBPT	AGE	EDUC	AWPT	Final Grade	M	S.D.	BBPT	AWPT	Final Grade
General Classification Test	F		.454	.291	.098	.421	.200	-.128	-.115	.115	-.069	.368	.295	.239	51.43	7.60	16.1	.18	.25
	R		.409	.114	.244	.377	.008	.001	-.018	.041	.075	.350	.477	.496	52.25	7.54	15.6	.20	.24
Arithmetical Reasoning Test	F			.074	.287	.477	.149	-.121	-.060	.064	.073	.374	.280	.272	49.97	7.46	16.2	.18	.25
	R			.065	.421	.263	.105	-.072	-.074	.031	.029	.173	.371	.358	48.30	7.86	15.6	.21	.26
Mechanical Aptitude Test	F				-.077	.395	-.284	.125	.214	.254	-.142	.185	.132	.120	54.79	7.03	15.7	.19	.26
	R				-.135	.219	-.113	.009	.144	.280	.101	-.035	.147	.195	59.40	3.64	15.0	.23	.27
Clerical Aptitude Test	F					.241	.030	-.055	-.090	.153	-.082	.268	.161	.114	49.24	7.52	16.0	.19	.26
	R					.271	.152	-.114	-.101	.151	-.002	.176	.244	.192	48.70	6.?	15.4	.22	.27
Spatial Test	F						-.108	-.019	.145	.288	-.043	.197	.326	.325	21.14	6.18	15.5	.18	.25
	R						-.065	.071	.018	.280	.104	.002	.343	.326	22.29	6.41	15.0	.22	.26
Experience Check List ECL-A	F							-.584	-.610	-.268	-.020	-.073	-.114	-.106	45.73	9.39	15.6	.19	.26
	R							-.658	-.732	-.217	-.149	-.110	-.114	-.094	46.04	9.61	15.2	.23	.28
Experience Check List ECL-B	F								-.286	.139	.014	.136	.126	.144	35.58	15.58	16.0	.19	.26
	R								-.029	.139	.086	.108	.042	.022	34.30	13.05	15.4	.23	.28
Experience Check List ECL-C	F									.179	.008	-.046	.005	-.020	15.47	15.95	16.2	.19	.26
	R									.156	.115	.044	.104	.094	16.19	14.41	15.5	.23	.28
Breech Block Performance Test	F										-.163	.008	.267	.201	47.20	16.23		.18	.25
	R										.115	-.053	.338	.341	46.66	15.59		.22	.26
Age	F											-.133	.169	.175	21.34	2.10	16.0	.19	.26
	R											.355	.331	.283	19.03	1.39	15.5	.22	.27
Education	F												.258	.176	11.19	1.54	16.2	.18	.26
	R												.264	.232	11.43	1.27	15.6	.22	.27
Average Weekly Performance Tests	F													.907	3.59	.19			
	R													.886	3.48	.23			
Final Grades	F														3.25	.26			
	R														3.12	.28			

$r_F > .20; > .26$ are significant at .05 and .01 levels of confidence.

$r_R > .15; > .19$ are significant at .05 and .01 levels of confidence.

Arithmetical Reasoning Test, Clerical Aptitude Test, and the spatial test. It should be recalled, in connection with Figure 1, that the recruit subjects were selected from individuals whose Mechanical Aptitude Test scores were above 55 while the fleet subjects had Mechanical Aptitude Test scores extending below this critical point. Thus, the finding that the recruit subjects had a higher mean and a smaller standard deviation on this test was anticipated.

The learning scores derived from the Breech Block Performance Test had about equal means and standard deviations for the two groups. One implication of this finding is that the two groups had approximately the same performance on a task similar to their training program, despite differences in their backgrounds. This will be discussed again later.

Both final grades and the average grades on weekly performance tests had higher means and smaller standard deviations for the fleet subjects than for the recruit subjects. From such findings one might conclude that the fleet subjects had achieved more in school than the recruit subjects. On the other hand, the better performance of the fleet subjects may have reflected differences in abilities between the two groups which existed before entering the school. The important question to ask is whether, in general, fleet and recruit subjects having similar scores on prediction tests perform similarly or differently with respect to school grades. To answer this question an analysis of covariance method developed by Gulliksen and Wilks (3) was employed, using a computational procedure developed by Dr. Ledyard R Tucker.*

With this covariance method it is possible to test three hypotheses: H_A: that the standard errors of estimating the criterion from a specified predictor(s) are equal for fleet subjects and recruit subjects; H_B: that the slopes of the regression lines or planes (regression of criterion on predictor(s)) are the same for the two groups; and H_C:

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*Dr. Tucker's procedure is presented in the appendix of Frederiksen, N., and Schrader, W. B., Adjustment to College. Princeton, New Jersey: Educational Testing Service, 1951.

that the criterion intercepts of the regression lines or planes are the same for the two groups. H_B assumed that H_A was supported; H_C, in turn, assumed that H_B was supported. If H_C was not rejected, then it is legitimate to consider that the same prediction formula could be used with both groups. If H_C was rejected (and H_A and H_B supported) then the two groups differ by a constant amount which would be incorporated in the prediction formulas. If either H_A or H_B is rejected, then separate prediction formulas are also warranted.

Several analyses of covariance were made in which final grades or weekly performance average grades were set as the criterion and the regressions of the criterion on various combinations of predictor variables were studied. The probability that the differences obtained between the recruit subjects and fleet subjects may have occurred as chance deviations from a true difference of zero was determined for each of the three hypotheses tested. In addition to the levels of significance of the differences, the magnitudes of the differences were also determined for the cases in which H_A and H_B were accepted. These magnitudes, which represent the distance between the criterion intercepts, were expressed in terms of pooled standard-error-of-estimate units and transformed into an estimate of the percentage of fleet subjects excelling the average recruit subject. The percentage thus estimates the advantage the fleet subjects had over the recruit subjects, for example, after differences in predictor scores have been taken into consideration. Table 2 summarizes these findings.

From Table 2 it becomes rather apparent that the regressions of both of the criteria upon various predictor variables resulted in all cases in either a significant difference in the slopes (H_B) or in the criterion intercepts (H_C) of the regression planes of the fleet subjects and the recruit subjects. It is also apparent that the fleet subjects had a definite advantage over the recruit subjects--in general, about 70 per cent of the fleet subjects exceeded the average recruit subject in terms of grades earned in the school. (If there were no difference, 50 per cent of the fleet subjects would, of course, exceed the average recruit subject.) The analysis failed to demonstrate a signifi-

TABLE 2

Differences between Grades Earned by Fleet and Recruit Personnel with Ability Held Constant

Criterion	Predictor(s)	H_A (errors of estimate)	H_B (slopes)	H_C (intercepts)	Advantage in σ_{est} Units	% Fleet Exceeding Average Recruit
Final grades	MA	.30 > P > .20	.20 > P > .10	.01 > P	.63	74
Final grades	GCT	.98 > P > .95	.01 > P	(.01 > P)	(H_B rejected)	
Final grades	ARI and MA	.50 > P > .30	.20 > P > .10	.01 > P	.57	72
Final grades	GCT and MA	.95 > P > .90	.01 > P	(.01 > P)	(H_B rejected)	
Final grades	GCT,ARI,MA,CA,Spa	.99 > P > .98	.10 > P > .05	.01 > P	.62	73
Final grades	BBPT	.50 > P > .30	.20 > P > .10	.01 > P	.50	69
AWPT*	MA	.10 > P > .05	.30 > P > .20	.01 > P	.63	74
AWPT	GCT	.50 > P > .30	.05 > P > .02	.01 > P	.61	73
AWPT	ARI and MA	.20 > P > .10	.50 > P > .30	.01 > P	.57	72
AWPT	GCT and MA	.50 > P > .30	.05 > P > .02	.01 > P	.66	75
AWPT	GCT,ARI,MA,CA,Spa	.50 > P > .30	.30 > P > .20	.01 > P	.64	74
AWPT	BBPT	.10 > P > .05	.30 > P > .20	.01 > P	.53	70

* Average grades on weekly performance tests.

cant difference between the standard errors of estimating the criterion from the predictor(s).*

The interpretation of Tables 1 and 2 may perhaps be clarified by examining the prediction of final grades on the basis of Mechanical Aptitude scores. The standard error of predicting final grades from Mechanical Aptitude scores and the slopes of the regression lines were about the same for the two groups. However, the criterion intercepts of the regression lines were significantly different. The regression lines for the two groups are shown in Figure 2.

Figure 2 represents the results reported in Tables 1 and 2 for Final Grades and Mechanical Aptitude Test scores. We have noted that the scores for the recruit subjects on the Mechanical Aptitude Test had a higher mean and a smaller standard deviation than the scores for the fleet subjects, whereas the final grades for the fleet subjects had a

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*A word should be interjected at this point concerning one of the P-values reported in Table 2. Investigating H_A for the regression of final grades on GCT, ARI, MA, CA, and Spa resulted in a P-value approaching unity, a P-value which suggested that the standard errors of estimate of the two groups were more alike that would normally be attributable to chance fluctuations. In order to obtain a solution it became necessary to carry out the computations to a greater number of places than usual, resulting in $.99 > P > .98$. It should be mentioned that one source of equating the errors of estimate might have been an error in computation or tabulating operations; an independent check was made of these operations and no error was uncovered. Another method which might have equated the standard errors of estimate for the two groups would be to scale the criterion separately for the two groups by means of the predictor variables, thus setting their standard errors of estimate equal; this definitely was not the case. Since the regression weights of the predictors were different for the two groups, the only explanation that seems plausible is that this was the one time in a large number of trials that the two groups would give chance differences this small. (Credit is due to Dr. Ledyard R Tucker and Miss Henrietta Gallagher for several suggestions and discussions about this rare occurrence.)
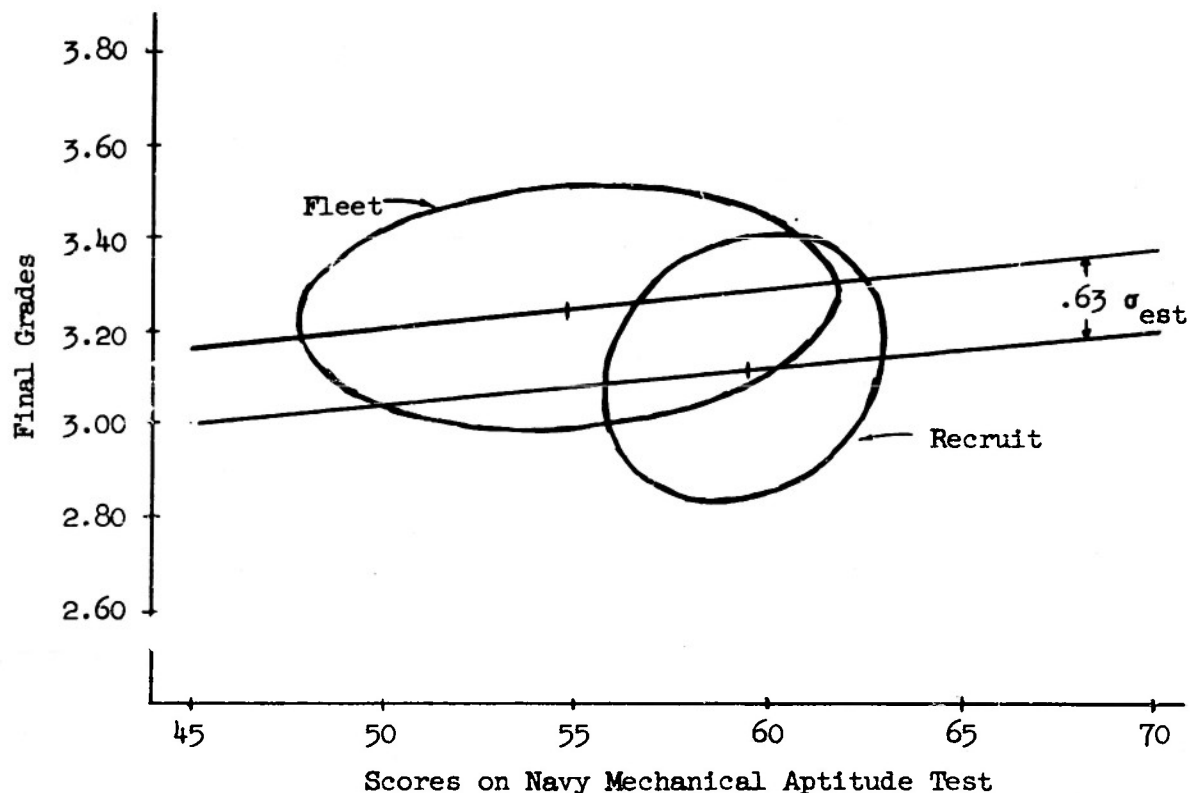
Figure 2. The relationship between final grades earned in Torpedoman's Mates
School and scores on the Navy Mechanical Aptitude Test. The
elliptical contours show that although the recruit subjects had a
higher mean score and smaller variability on the Mechanical Aptitude
Test than did the fleet subjects, the fleet subjects earned a higher
mean grade in school than did the recruit subjects. The contours
also illustrate the fact that the regression lines were approxi-
mately parallel for the two groups and separated by a distance equal
to .63 of a pooled-standard-error-of-estimate unit. (The ellipses
were obtained from the general standard score formula
$$Z_x^2 + Z_y^2 - 2r_{xy}Z_xZ_y = 1.)$$

higher mean and a smaller standard deviation than did grades for the recruit subjects. It was also found that the standard errors of estimating final grades from scores on the Mechanical Aptitude test, and the slopes of the appropriate regression lines, were not significantly different for the two groups. However, the recruit and fleet regression lines intersected the grade axis at different points.

What all this means is essentially this: If prediction of final grades were based upon Mechanical Aptitude test scores only, then for a given score on the Mechanical Aptitude test two predicted grades might be considered, corresponding to the two regression lines indicated in Figure 2. If the subject under consideration came from a recruit training center, we would estimate his most likely final grade as the lower of the two possible grades. On the other hand, for a fleet subject we would use the upper regression line to obtain an estimate of his most likely school grade. We might note that were all predictions to be based upon the regression line for the fleet subjects, the recruits would tend to earn grades in school below their predicted grade, and hence would be classified as "underachievers," whereas the converse would occur if we employed only the regression line for the recruit subjects.

To summarize thus far, the results indicated that fleet subjects earned higher grades, both final grades and weekly performance grades, in a Torpedoman's Mates School than did recruit subjects of similar ability as measured by tests from the Navy Basic Battery. A parallel result was obtained when the subjects were controlled on learning ability based upon the Breech Block Performance Test. These findings strongly favor separate selection procedures for the two groups; if a cutting score is to be used, different critical scores should be used for the two groups. The findings also suggest that there are factors associated with fleet duty which lead to better performance in this training school.

The influence of age, education, previous mechanical experience, and learning ability on the relations between test and criterion measures. Age and education were two factors which might be associated with the better performance of the fleet subjects. Analysis of these factors showed that both variables had low but significant correlations with final grades and weekly performance grades. (These correlations are reported in Table 1.)

From Table 1 it will be observed that the fleet subjects were some-
what older and their ages spread over a longer span than the recruits.
With respect to education the two groups were about the same. The means
and standard deviations of grades and also the correlations with school
performance were essentially alike for the two groups.

Age and education were combined with the Mechanical Aptitude Test
and the multiple regressions of the criteria on these variables were
analyzed by the covariance method discussed earlier. The results are
reported in Table 3 and indicate that the fleet subjects earned higher
grades than recruit subjects of similar ability and background on these
variables. The essential difference between the regression planes lies
in their criterion intercepts--the distance between intercepts was .36
of a standard-error-of-estimate unit. This distance indicates that
approximately 64 per cent of the fleet subjects earned higher grades
than the average recruit earned.

Another factor to be considered was previous experience in mechan-
ical-motor operations. The three scores (ECL-A, ECL-B, and ECL-C) from
the Experience Check List were used as one basis for evaluating past
experience in the mechanical-motor area. Surprisingly enough, the
means and standard deviations of the three categories (see Table 1)
were approximately the same for the fleet and recruit subjects. More-
over, the zero-order correlations between these scores and grades
earned in the school were not significantly greater than zero. As
defined by this instrument, previous mechanical-motor experience was
not a factor relevant to success in the Torpedoman's Mates School.

However, the ECL-A scores did have significant negative correla-
tions with the learning scores from the Breech Block Performance Test
and indicates that fleet or recruit personnel who had had limited ex-
perience in a variety of mechanical-motor tasks tended to earn low
scores on the learning task. For the fleet subjects, there was also
a significant correlation between the ECL-A and ECL-C scores and scores
on the Mechanical Aptitude Test.

The learning measures permitted a further analysis of possible
transfer effects which might have favored the fleet subjects. The re-

TABLE 3

Differences between Grades Earned by Fleet and Recruit Personnel
with Mechanical Aptitude, Age, and Education Held Constant

Criterion	Predictors	H_A (errors of estimate)	H_B (slopes)	H_C (intercepts)	Advantage in σ_{est} Units	% Fleet Exceeding Average Recruit
Final grades	MA, Age, Educ	.50 > P > .30	.50 > P > .30	.05 > P > .02	.37	64
AWPT*	MA, Age, Educ	.10 > P > .05	.50 > P > .30	.05 > P > .02	.36	64

*Average grades on weekly performance tests.

gressions of the learning scores (from the Breech Block Performance Test) upon various combinations of predictor variables were studi i to determine whether fleet subjects performed better on the learni g task than did recruit subjects of similar ability as measured by Basic Battery tests.

It might be added parenthetically that none of the subjects reported any previous exposure to the specific task of assembling or disassembling the breech block mechanism. The results presented in Table 4 are far from conclusive; some of the regression lines or planes had significant differences in their intercepts, others did not. It should be mentioned that the purpose for using multiple predictors is to reduce the errors made in the prediction process; however, the covariance method employed in this study has a characteristic that as the standard error of estimate is reduced (by increasing the number of predictor variables), the occurrence of a significant difference becomes more likely. This is possibly what happened with the values reported in Table 4. However, it is again evident that fleet subjects had a tendency to excel the average recruit subject.

The findings that fleet subjects tended to do better on the learning task than recruits suggested that the regressions of final grades and weekly performance grades on the learning scores be investigated. This would enable us to determine whether fleet and recruit students of similar scores on the learning task, which to some extent incorporated background differences between the two groups, earned about the same grades in the course. As we saw in Table 2, the regressions of both final grades and weekly performance grades upon the learning measures resulted in significant differences in the criterion intercepts (i.e., rejection of H_c). About 70 per cent of the fleet subjects exceeded the average recruit subject when the groups were controlled on the basis of learning scores. These findings indicate that there was a residual variance still to be accounted for when past experience was taken into consideration by means of the learning measures. However, it should be pointed out that the unreliability of the control variable (Breech Block Performance Test) introduces a bias into the analysis, and any interpretation that differences in experience between the two groups could not

TABLE 4

Differences between Learning Scores Earned by Fleet and Recruit Personnel with Ability Held Constant

Criterion	Predictor(s)	H_A (errors of estimate)	H_B (slopes)	H_C (intercepts)	Advantage in σ_{est} Units	% Fleet Exceeding Average Recruit
BBPT	GCT	.70 > P > .50	.70 > P > .50	.80 > P > .70	.04	52
BBPT	MA	.70 > P > .50	.20 > P > .10	.05 > P > .02	.27	61
BBPT	GCT and MA	.70 > P > .50	.30 > P > .20	.05 > P > .02	.27	61
BBPT	MA and ARI	.70 > P > .50	.30 > P > .20	.10 > P > .05	.27	61
BBPT	GCT,ARI,MA,CA,Spa	.70 > P > .50	.70 > P > .50	.05 > P > .02	.30	62

account for all of the residual variance should take this biasing factor
into consideration. Further research would be necessary to determine
how much of the residual variance between the two groups could be attri-
buted to experience.

The factors hypothesized to account for better performance of fleet
personnel. What factors then might have accounted for the better perform-
ance of subjects coming from the fleet? It should be obvious to the
reader that, although the study did establish that fleet personnel per-
formed better in school than recruit personnel when controlled on a
number of factors, it was beyond the scope of the present study to
identify the factors leading to the better performance of fleet personnel.
The following hypotheses were developed a posteriori as suggestions for
further research:

1. Motivation--the desire for professional advancement in the
Navy, an expressed interest in the subject matter, greater responsibility
to self and Navy, and recognition of the importance of adequate training
may have led to greater motivation on the part of the fleet subjects.
If many of the fleet subjects were men who had chosen the Navy as a
career, one would consequently expect stronger motivation than for re-
cruits. Also, there may have existed the possibility that recruit sub-
jects were taking a rather disinterested view of any training in the
Navy and were merely "sweating it out."

2. Transfer effects from fleet experience--the type of duty that
the fleet subjects had experienced abcard ship may have facilitated the
acquisition of mechanical-motor skills by means of transfer. Some indi-
cation that transfer effects were operating was suggested by the findings
that the fleet subjects had slightly higher scores on the learning task
than had recruit subjects of similar ability. However, the effects of
transfer probably did not account for all of the difference between the
two groups, as is suggested by the finding that the regressions of
final grades on the learning measure (which tended to partial out the
transfer effects) were significantly different for the two groups.

3. Adjustment to Navy life--the greater indoctrination period
for the fleet subjects may have resulted in greater rapport with the
instructors and staff members of the school, and, in general, may have

meant that the fleet subjects had fewer social and psychological adjust-
ments to make. The recruit subjects may have had a greater number of
distracting and disturbing elements hindering their learning process.

It would seem extremely desirable to undertake research to isolate
the factors associated with the better performance of the fleet subjects.
Judging from the results obtained by Frederiksen and Schrader (2) in
which they found a tendency for veterans to overachieve in college, we
might expect to find that fleet subjects enrolled in most all types of
Navy training schools will perform better relative to ability than re-
cruit subjects. If so, the crucial factors contributing to better per-
formance may have an influence upon training procedures and policies.

Summary and Recommendations

Students selected for training in a Torpedoman's Mates School are
drawn from either the fleet or recruit training centers. The primary
purpose of this study was to determine what influence this difference
had upon the relationships between test scores and measures of success
in that school. The findings show that students from the fleet earned
higher grades in the Torpedoman's Mates School than did recruit students
when scores on tests from the Navy's Basic Battery were taken into ac-
count. Thus, this difference in background does influence the relation-
ships between test scores and performance in the school, and to such a
degree that separate selection procedures for the two groups appear ad-
visable. The results of the study suggest that there are factors associ-
ated with fleet duty which contribute to better performance in the school.

In an attempt to eliminate certain factors which would account for
the difference between the two groups, such factors as age, education,
previous mechanical-motor experience, and transfer effects from train-
ing or experience gained aboard ship were investigated. The results
indicated the fleet subjects were older and more heterogeneous with
respect to age than the recruits, but that age did not appear to account
for the differences between the two groups. Education turned out to be
a factor operating about the same for both fleet and recruit subjects.
Previous mechanical-motor experience, as defined by an experience check

list, failed to demonstrate significant correlations with practically all predictor and criterion variables used in the study. Transfer effects from training and experience gained aboard ship were shown to be operating slightly in favor of the fleet subjects. However, these factors did not seem to account for the major portion of the differences between the fleet subjects and the recruit subjects.

It was not possible in this study to determine the relevant variables facilitating the better performance of the fleet subjects. However, three factors were hypothesized to account for the results favoring the fleet subjects: (1) motivation, (2) transfer effects of previous training and experience, and (3) adjustment to Navy life.

Further studies are recommended to determine (1) whether fleet subjects perform better in other Navy schools than do recruit subjects of similar ability, and, if this is true, (2) what factors are operating to account for the better performance of fleet subjects, and (3) whether there might exist an optimal exposure to Navy life which would tend to maximize the benefits from Navy training. Results of such studies would be of considerable importance to the Navy, not only for classification and selection procedures, but also for policies and procedures pertaining to the training of manpower.

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